



Armed Forces College of Medicine

AFCM

Physiology of The Sensory System



By

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Neuroscience Physiology

Lecture 3: Classification of Sensations

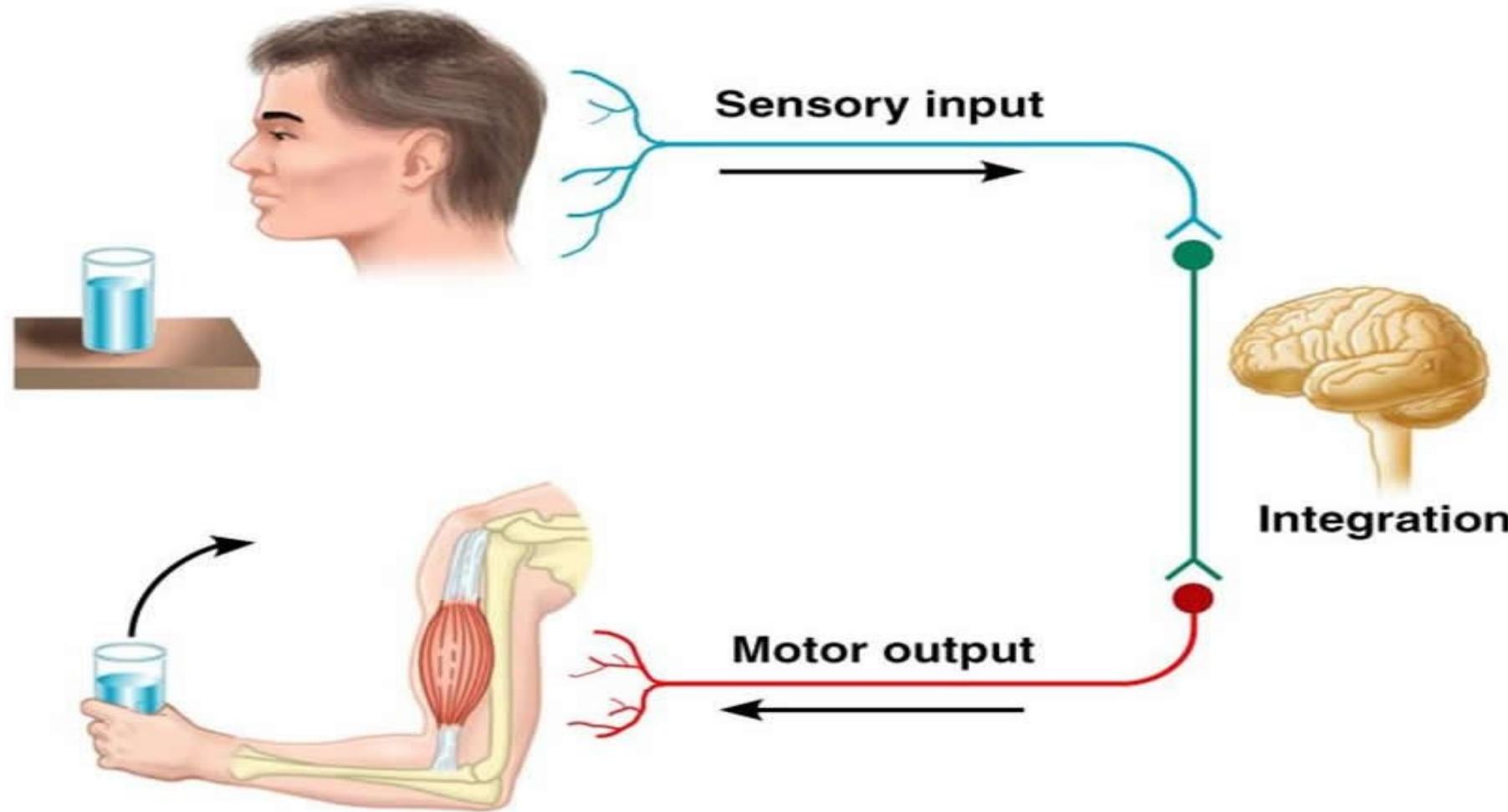
INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be able to:

1. Classify sensations according to the modality.
2. List the mechano-receptive sensation.
3. Explain crude and fine touch.
4. Explain tactile localization and discrimination.
5. Describe pressure, vibration, itch and tickle sensations.

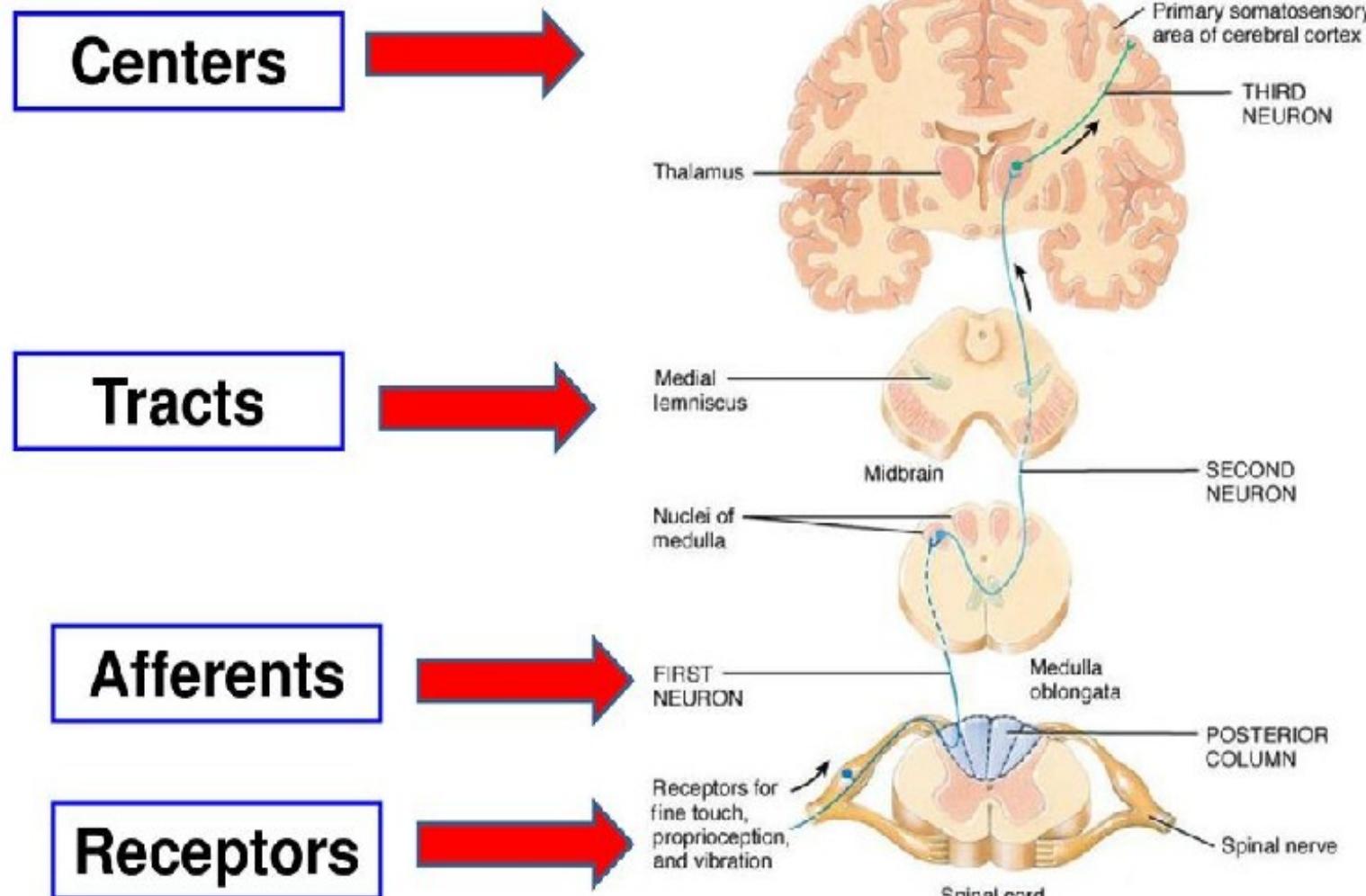
Functional Divisions of The Nervous System



Fox 14th Ed.



Component of The Sensory System



Sensations



smell



touch



hearing



sight

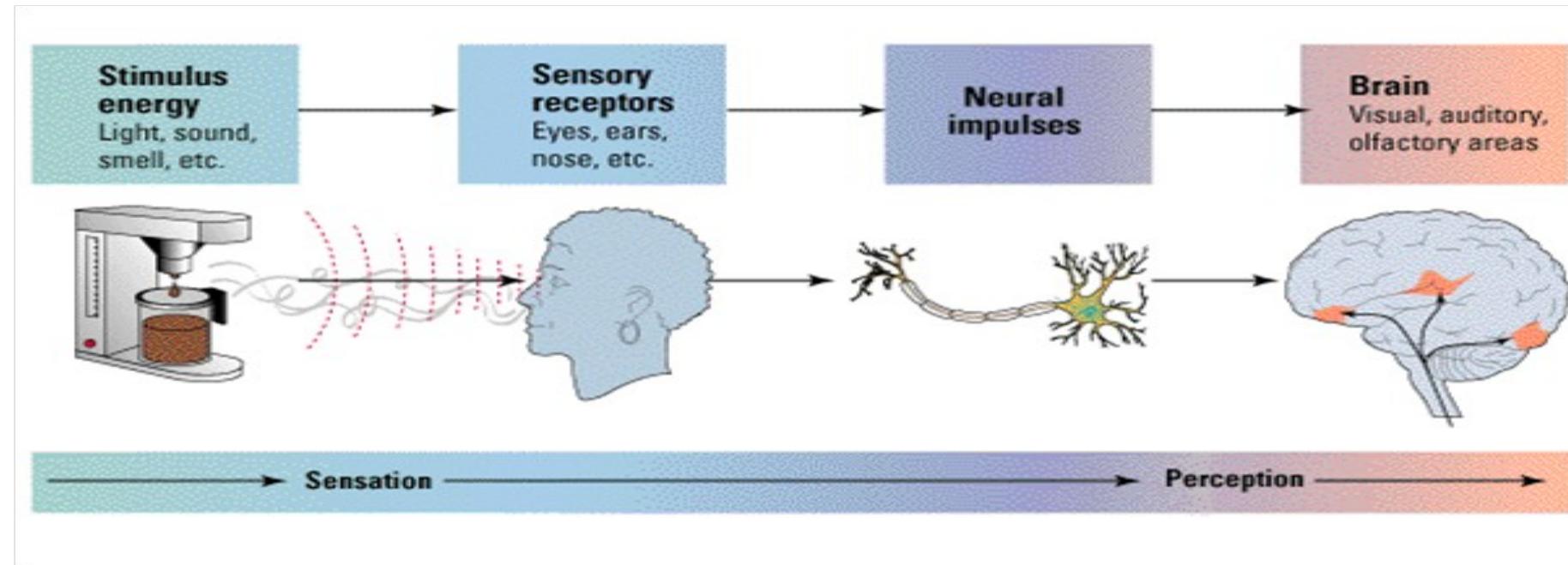


taste

Sensation:

- **Sensation is the feeling produced by change in the environment (Internal or External).**
- **Produced by application of stimulus to the receptors, or sensory pathway.**

Perception of Sensations



Perception:

- Is the understanding of sensation's meaning.
- Pain is a sensation, but awareness of the type, site and intensity is a perception.

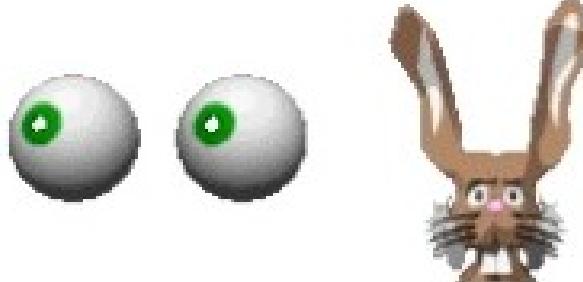
Sensations Vs. Perception



Sensation



Is your window to the world

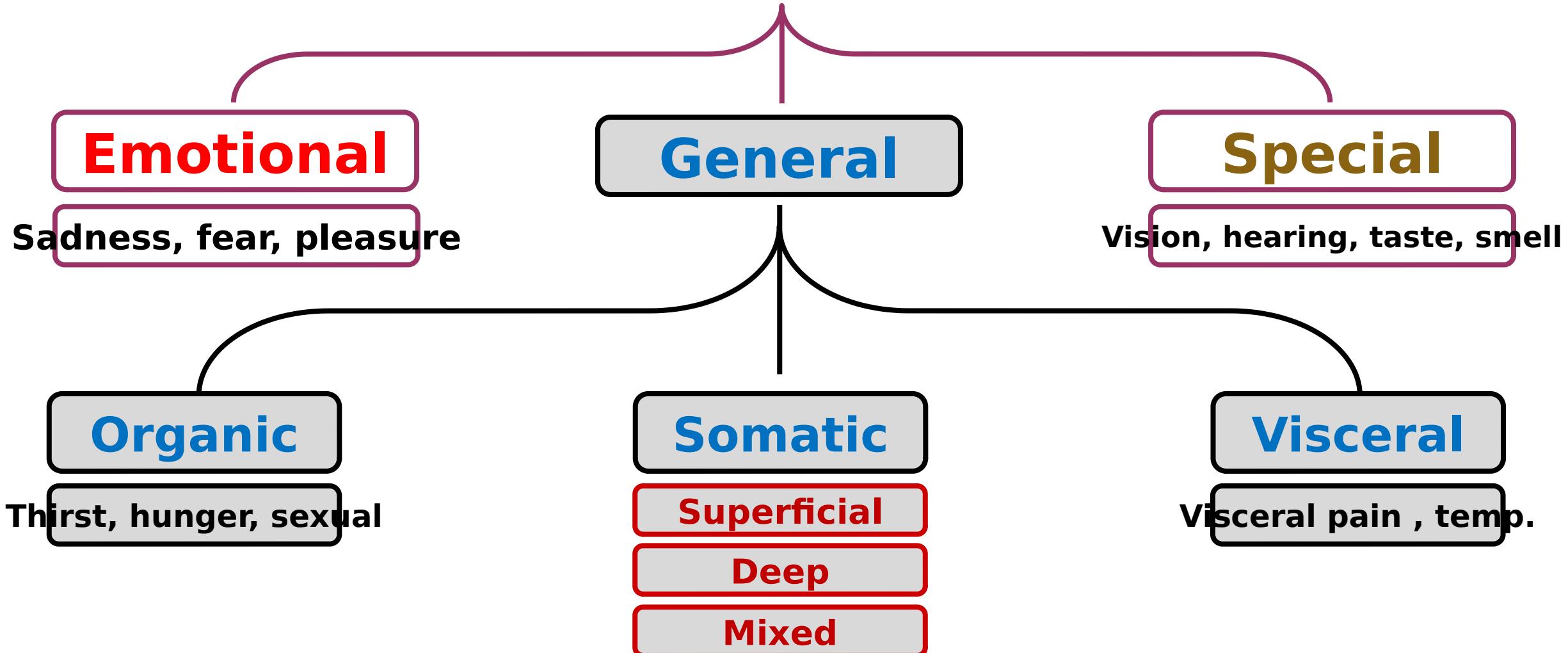


Perception

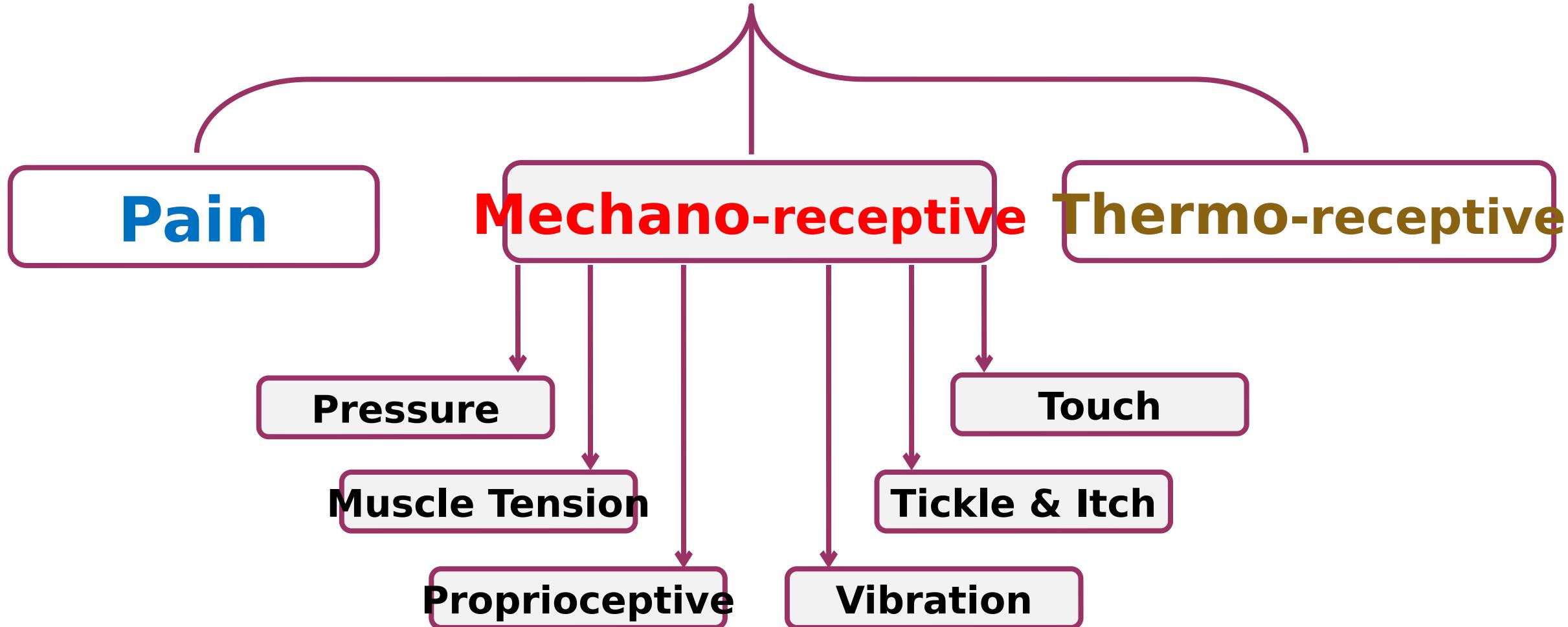


Interpreting what comes in your window

A) Anatomical Classification of Sensations

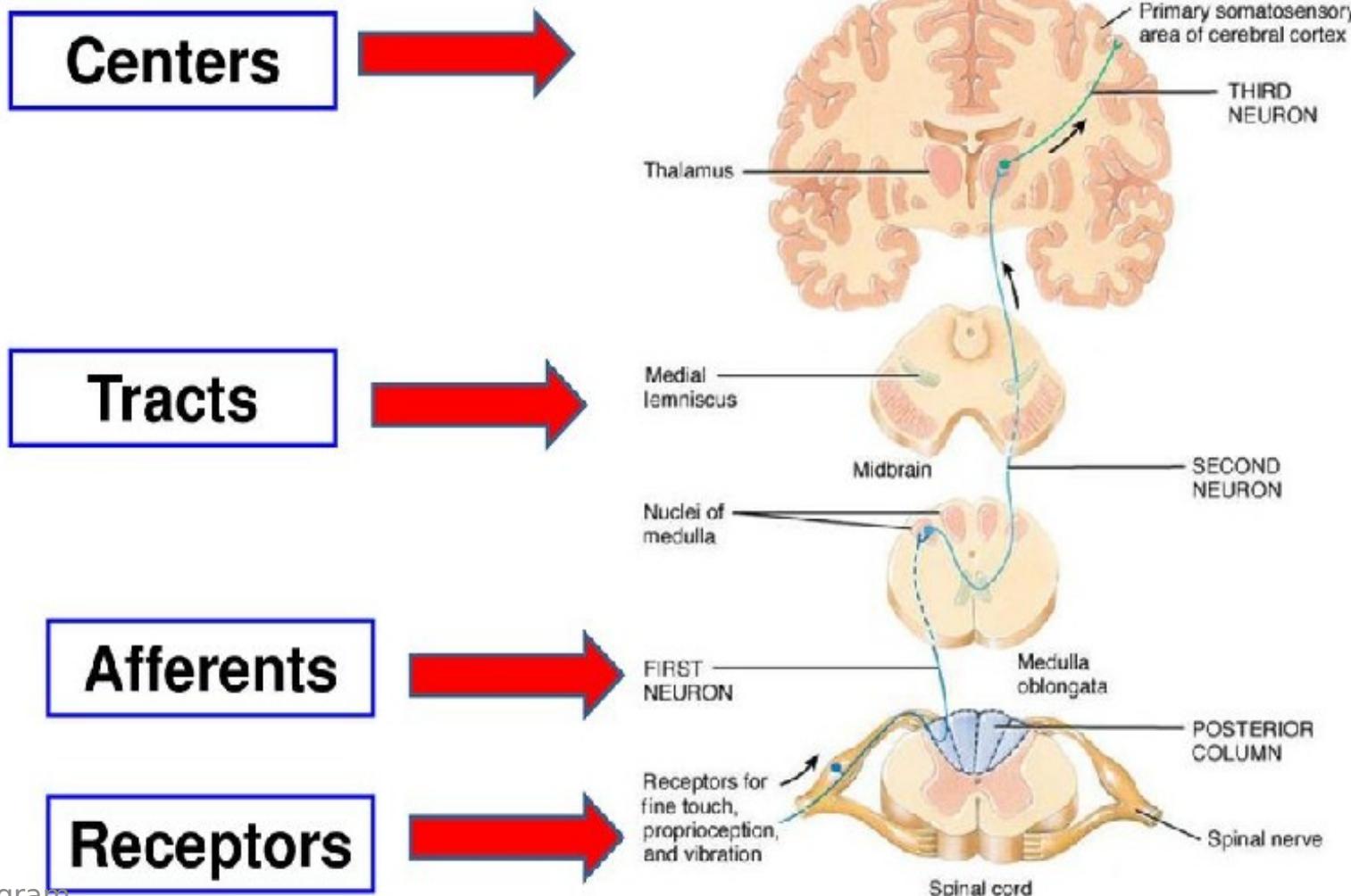


A) Physiological Classification of Sensations





Component of The Sensory System



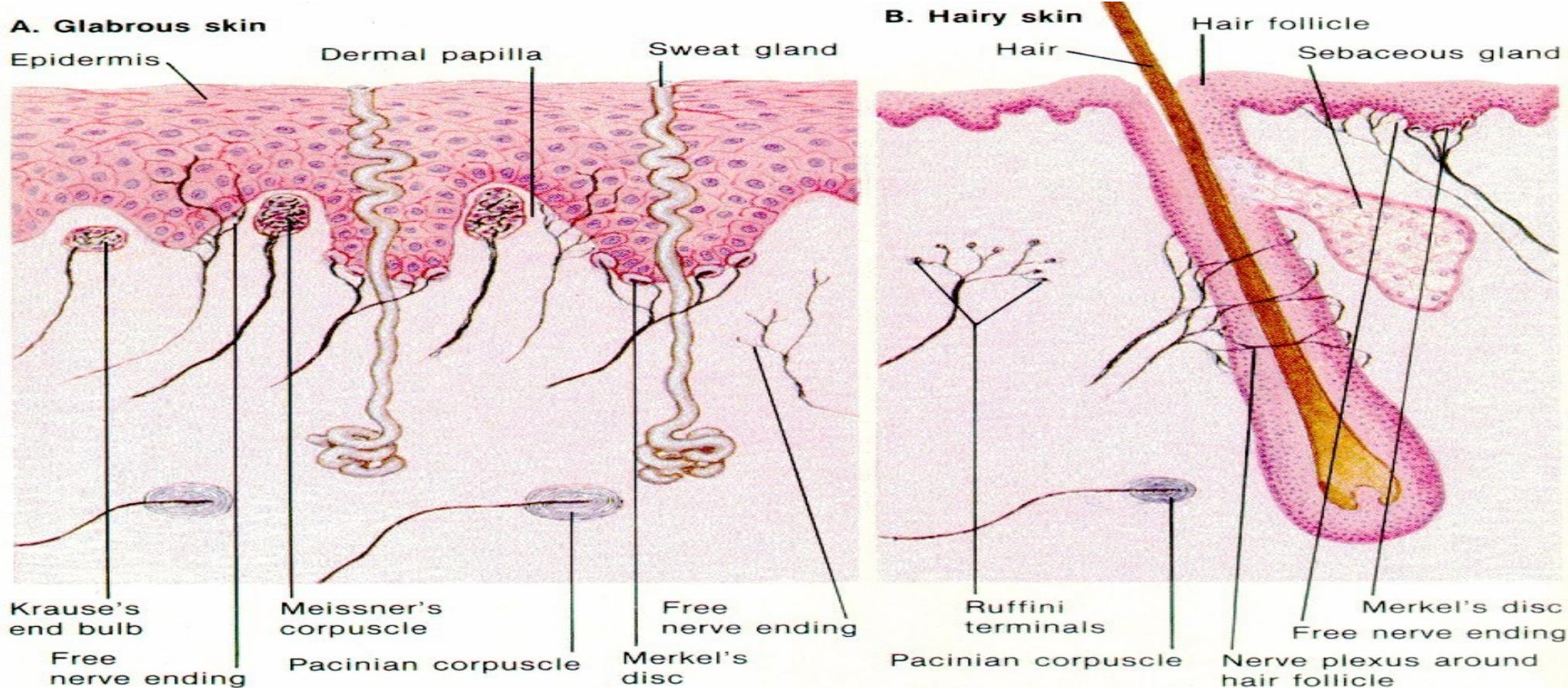


Touch Sensation

	Crude Touch	Fine Touch
Definition	Ability to detect contact of the body with any object	
Character	Poor localization	Well localized
Receptor	<ul style="list-style-type: none">- <u>Site</u>: Present in the skin mainly in finger tips, lips, hairy area	
	1) Free nerve endings	1) Meissners's corpuscles
	2) Hair end organs	2) Merkel's discs
	Mechano-receptors	
	Mechanism of stimulation: Tissue displacement or deformity	
Rapidly adapting		
Afferent N.	A δ & C	A β
Tract	Ventral spinothalamic	Dorsal column
Centre	Thalamus	Cerebral cortex
Examination	Cotton wool test	

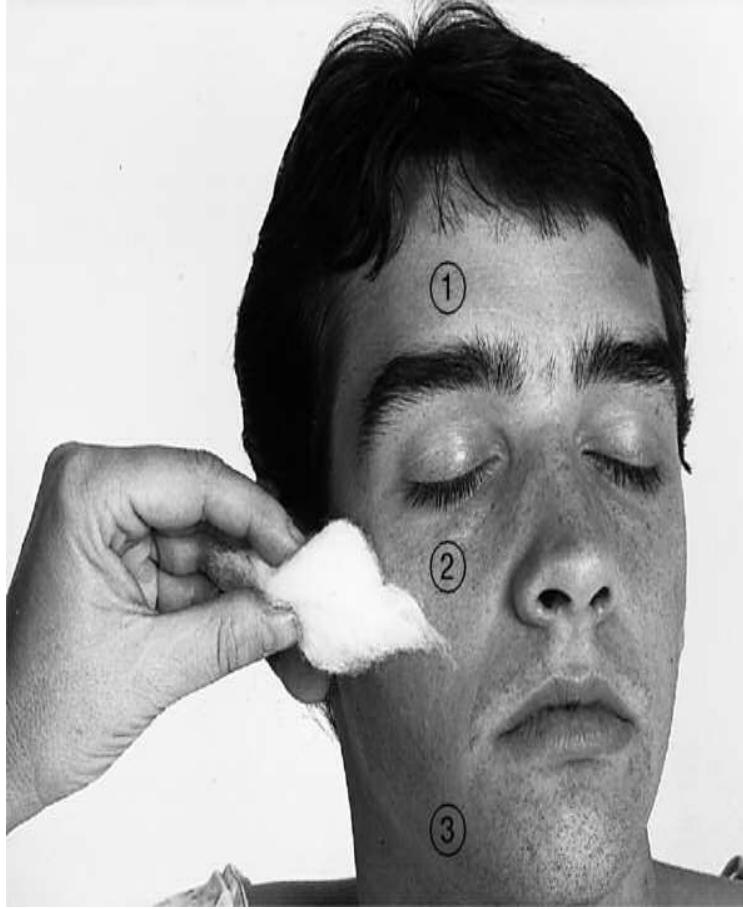


Touch Receptors



Guyton 13th
Ed.

Crude (Light) Touch



Fine Touch



Tactile Localization

**Tactile
Discrimination**

Stereognosis

Texture of material

Fine Touch



	Tactile Localization	Tactile Discrimination
Definition	Ability to localize a touched point	Ability to detect 2 points
Receptor		
Afferent N.		
Tract		
Centre		
Examination	2-markers test	Weber's compass

Tactile (2-points) Discrimination



Threshold Distance:

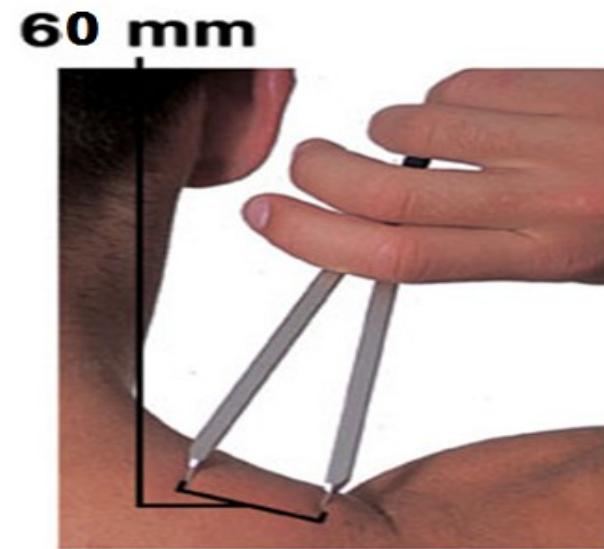
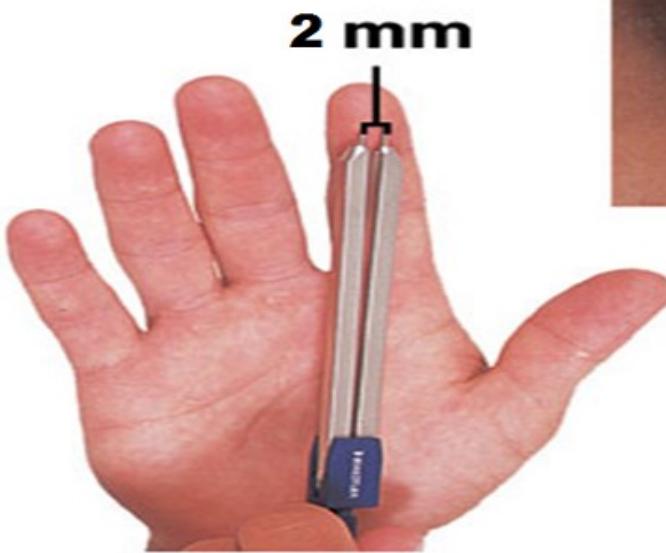
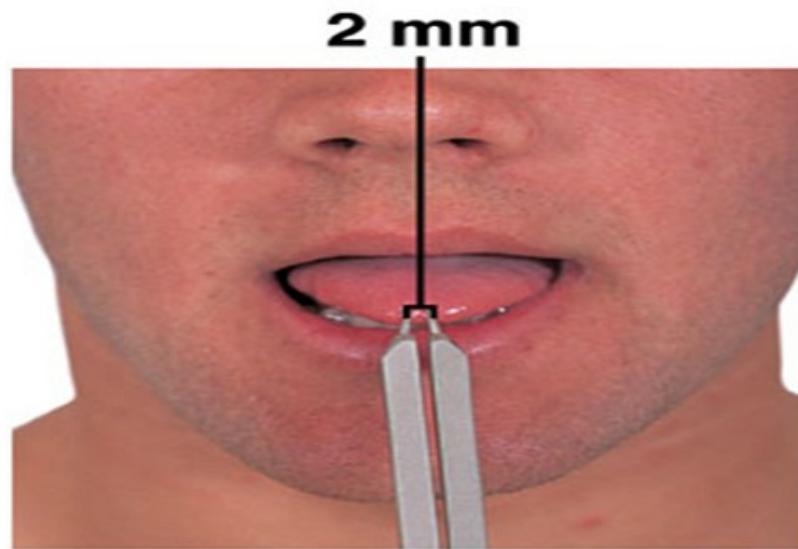
- Minimal distance between 2 touched points to be felt as 2 separate points.
- Is variable in different areas of the body.
- The shorter the threshold distance, the more acute tactile discrimination.



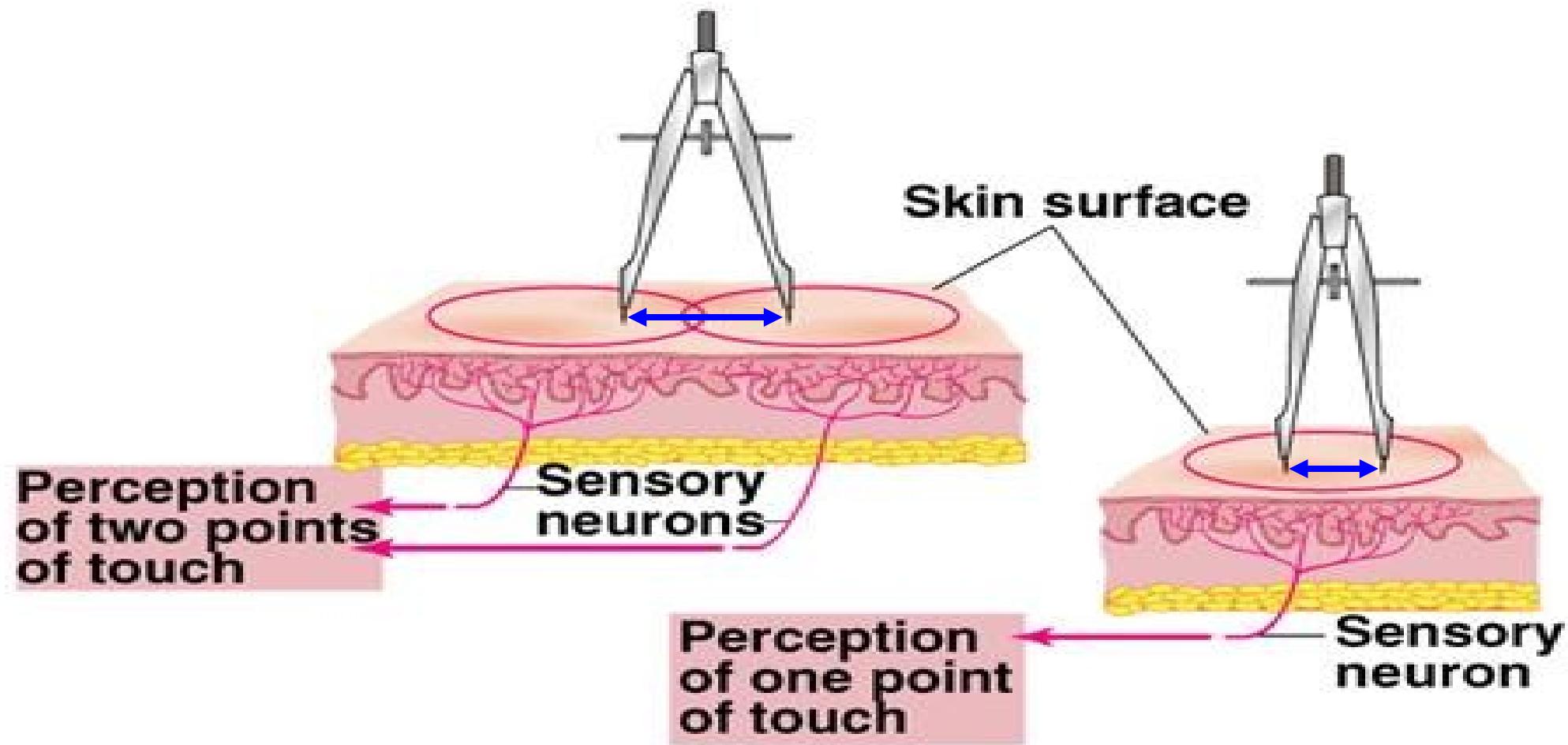
Factors Controlling:

1. Number of receptors in this area.
2. Number of afferent sensory nerves.
3. Presence of convergence in the sensory pathway.
4. Area of representation in the sensory cortex.

Threshold Distance



Tactile (2-points) Discrimination



Sensory Unit & Receptive Field

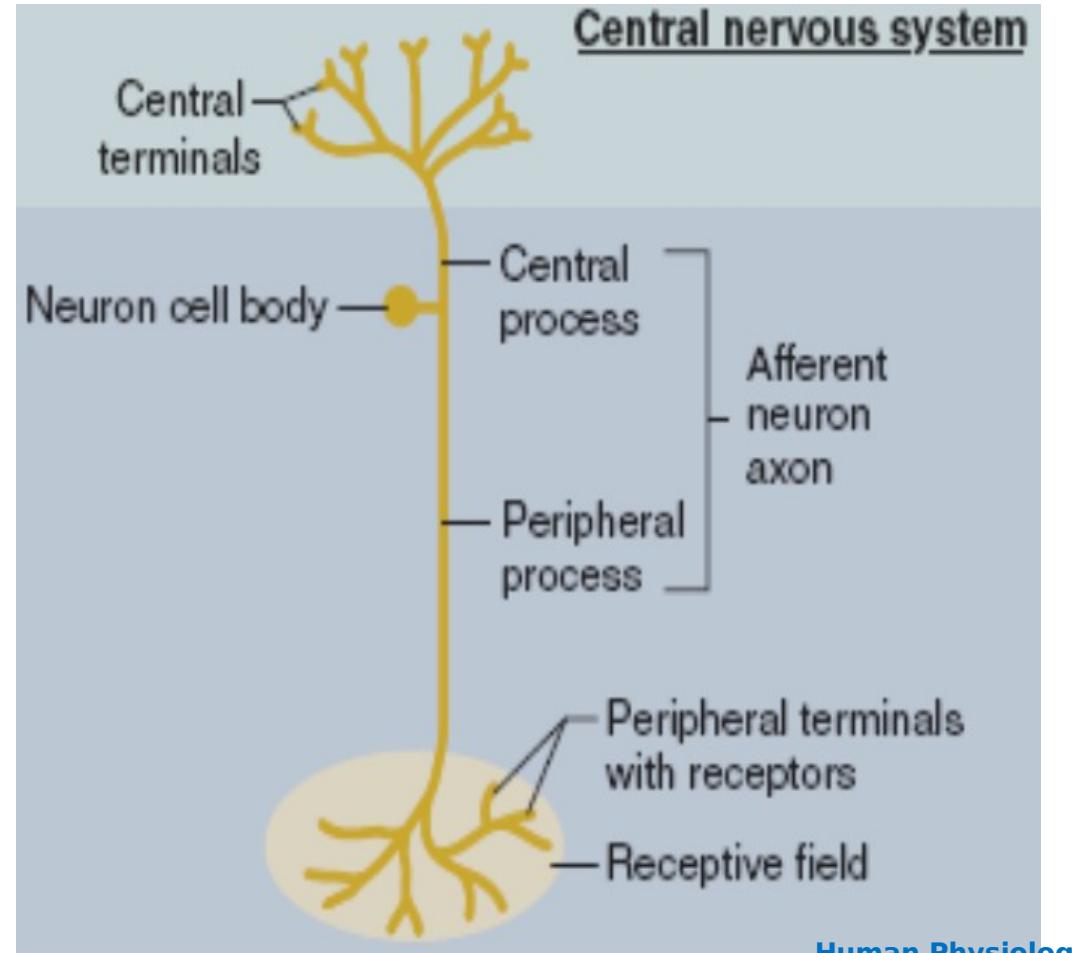


Sensory Unit:

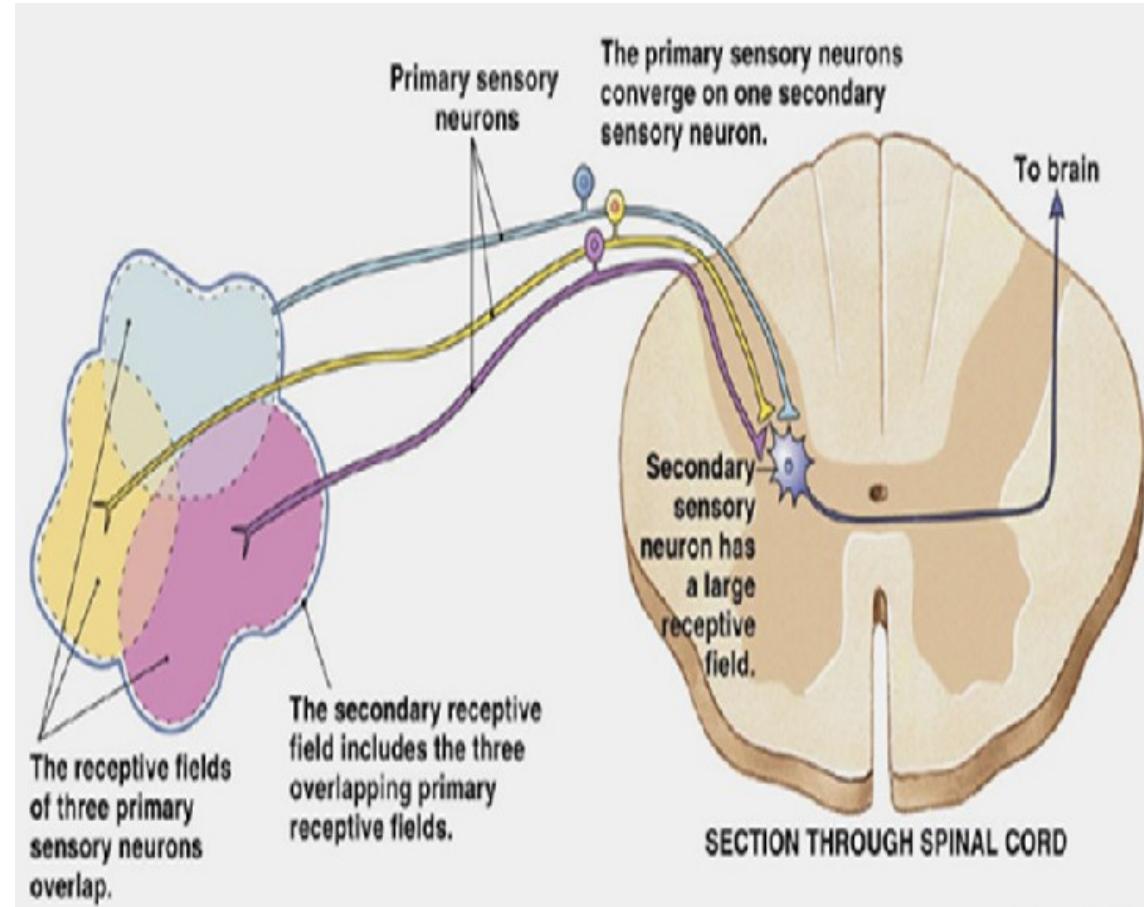
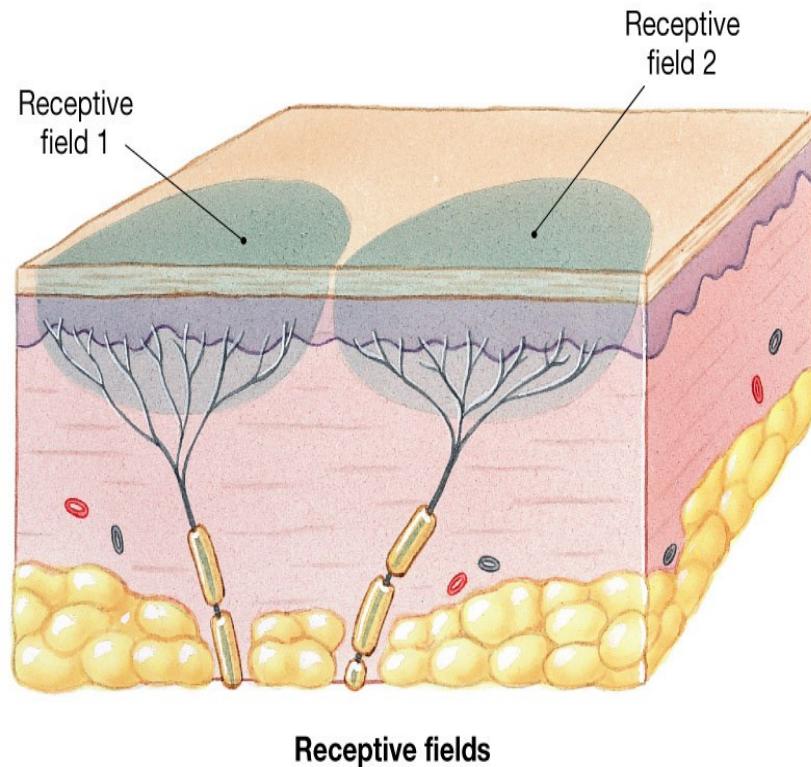
- **Consist of a single afferent N. + all its branches + receptors .**

Receptive Field:

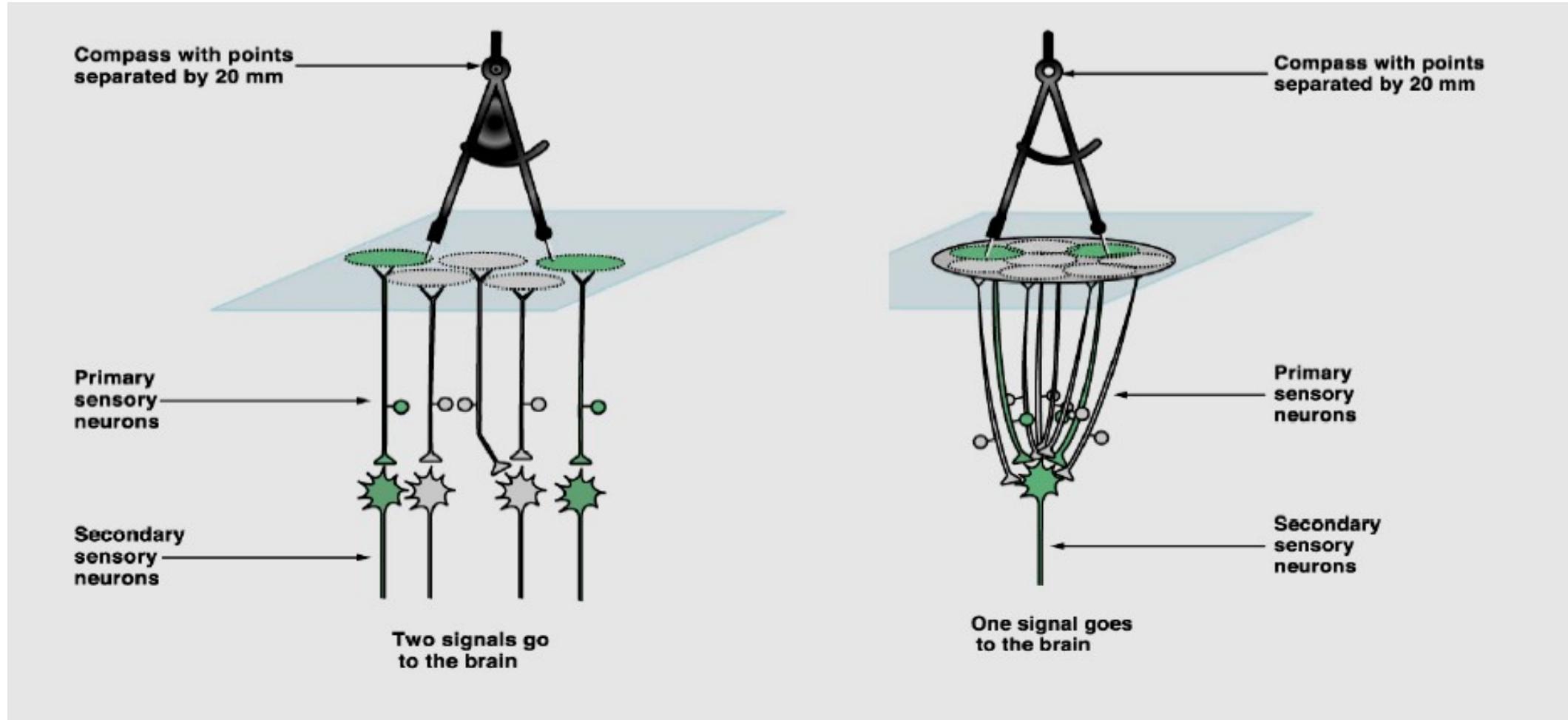
- **Area of skin supplied by single afferent N. (= sensory unit)**
- **Some degree of overlap is present between neighbouring receptive field.**



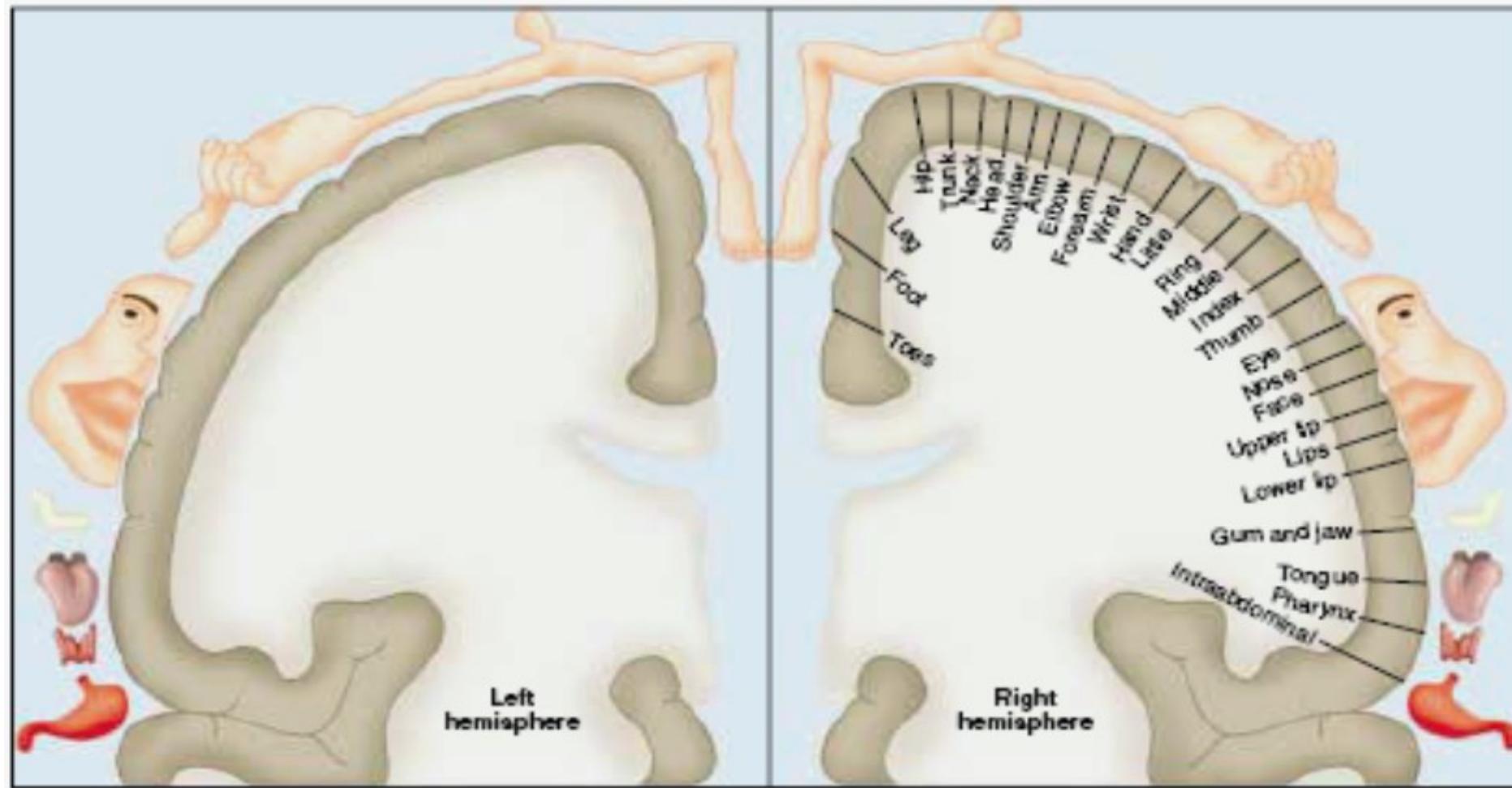
Sensory Unit & Receptive Field



Convergence in Sensory Pathway

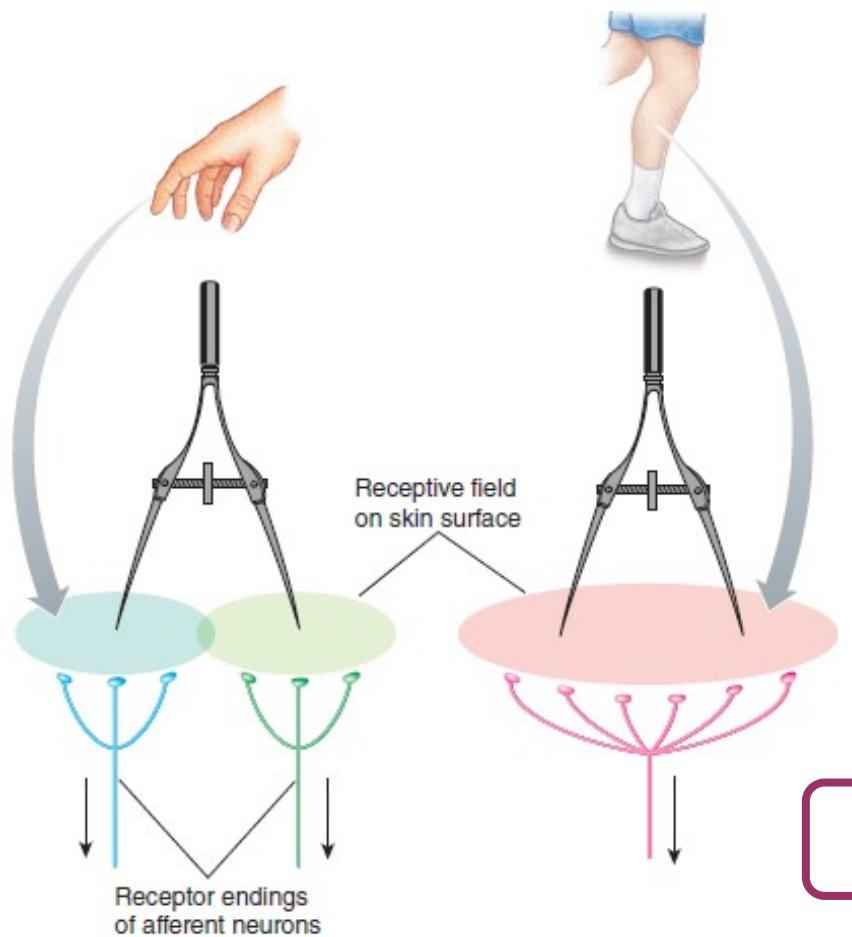


Cortical Representation



Human Physiology
9th Ed.

Acute Discrimination



The wider cortical representation

The lesser the convergence

The smaller the receptive field, the more the receptor density

Sherwood
9th Ed.



Stereognosis



Stereognosis	
Definition	Ability to identify familiar objects by handling it while eyes are closed
Receptor	Touch & Pressure
Afferent N.	  
Tract	
Centre	
Examination	Using familiar object (e.g. key, pen or coin)

Texture of Material



	Texture of Material
Definition	Ability to know the texture of different material with the eyes closed
Receptor	
Afferent N.	
Tract	
Centre	
Examination	Using a piece of cloth

Pressure Vs. Muscle Tension



	Pressure	Muscle Tension
Definition	Ability to know the weight of objects	
Receptor	Skin & subcutaneous tissues	Tendons of the muscles
	1) Pacinian corpuscles 2) Ruffini's endings	Golgi tendon organs
	Mechano-receptors	
	Mechanism of stimulation: Tissue displacement or deformity	
	Slowly adapting	
Afferent N.	A β	
Tract	Dorsal column	
Centre	Cerebral cortex	
Examination	Different weights on supported hand	Different weights on unsupported hand

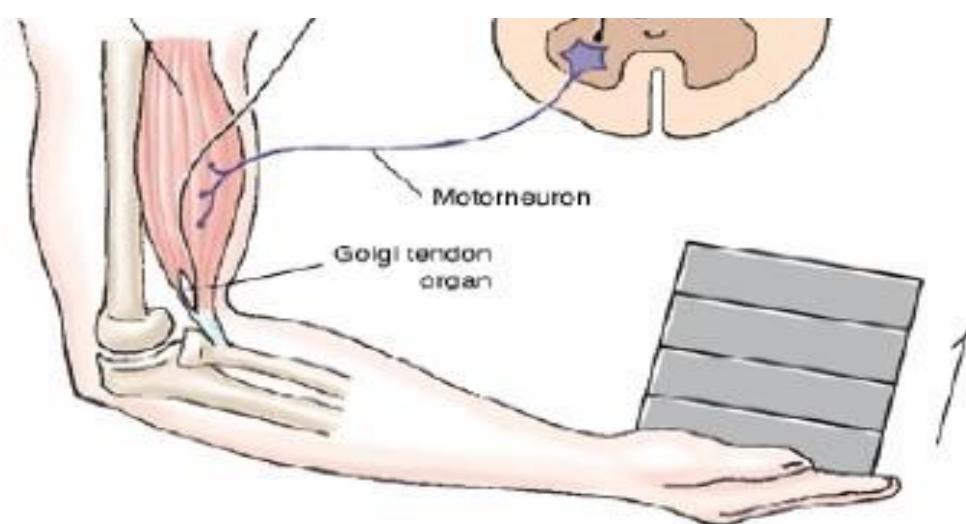
Pressure Vs. Muscle Tension



Pressure sense



Muscle Tension



Tickle & Itch Sensations



	Tickle	Itch
Definition	Pleasurable sensation	Annoying sensation
Character		Initiates scratch reflex
Receptor	- <u>Site</u> : Superficial layer of the skin	
		Free nerve endings
		Mechano-receptors
	Mechanism of stimulation: Tissue displacement or deformity	
		Rapidly adapting
Afferent N.		C
Tract		Ventral spinothalamic
Centre		Thalamus
Examination	Light moving thing	<ul style="list-style-type: none"> • Moving tactile stimuli • Chemical substance (Histamine)

Tickle & Itch Sensations



Tickling



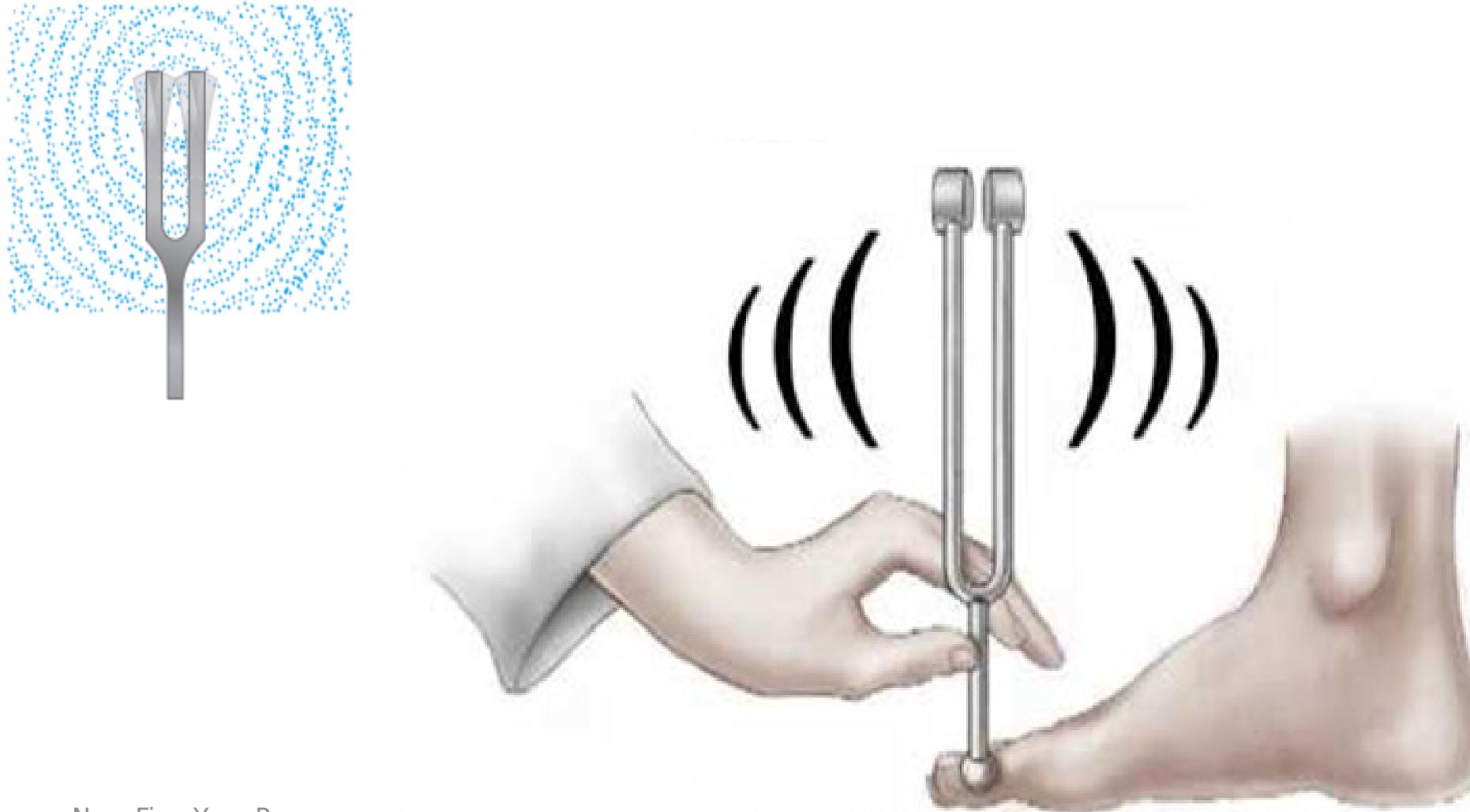
Itching



Vibration Sense

Vibration	
Definition	The sense arises from rapid <u>repetitive</u> tactile stimulation
Receptor	<ul style="list-style-type: none">- <u>Site</u>: Both skin & subcutaneous tissues1) Meissners's corpuscles (up to 80 Hz)2) Pacinian corpuscles (up to 500 Hz) <p>Mechano-receptors</p>
	Mechanism of stimulation: Tissue displacement or deformity
	Receptors are rapidly adapting but the sense itself is non adapting
Afferent N.	A β
Tract	Dorsal column
Centre	Cerebral cortex
Examination	Using a vibrating tuning fork

Vibration Sense



Sherwood
9th Ed.

Proprioceptive (Kinesthetic) Sensations



	Sense of Position	Sense of Movement
Definition	Ability to feel the <u>position</u> of body parts	Ability to feel the <u>movement</u> of body parts
Character	Static	Dynamic
Receptor		Deep structures
1) Ruffini's endings 2) Golgi tendon organs 3) Muscle spindles		Pacinian corpuscles
Mechano-receptors		
Mechanism of stimulation: Tissue displacement or deformity		
Slowly adapting		Rapidly adapting
Afferent N.	A β	
Tract	Dorsal column	
Centre	Cerebral cortex	
		Posterior limb of internal capsule

Proprioceptive (Kinesthetic) Sensations



Lecture Quiz



**What is the difference between
Conscious & Unconscious
Sensations**



Lecture Quiz



Classify

**Sensations according to their
Sensory Pathway**



Lecture Quiz



What is the difference between
Epicritic & Protopathic
Sensations



touch



see



hear



taste



smell

SUGGESTED TEXTBOOKS



1. **Guyton and Hall**

Text book of Medical Physiology, 13th Edition (2016)

2. **Ganong's**

Review of Medical Physiology, 24rd Edition

3. **Fox**

Human Physiology, 14th Edition

4. **Sherwood**

Human Physiology .. From Cells to Systems, 9th Edition



THANK YOU